Space and Defense Power Systems

FY 2012 Nuclear Reactor Technologies Summit

March 20, 2012

Owen Lowe, Director

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

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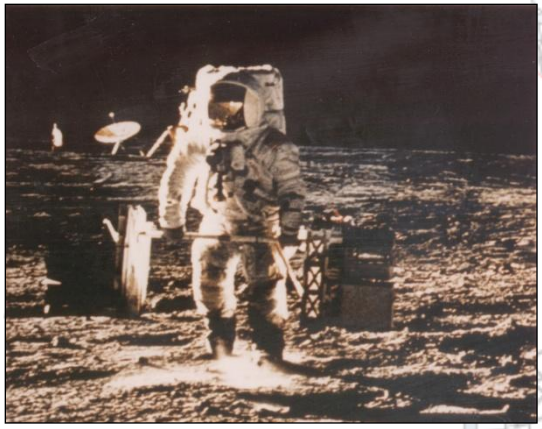
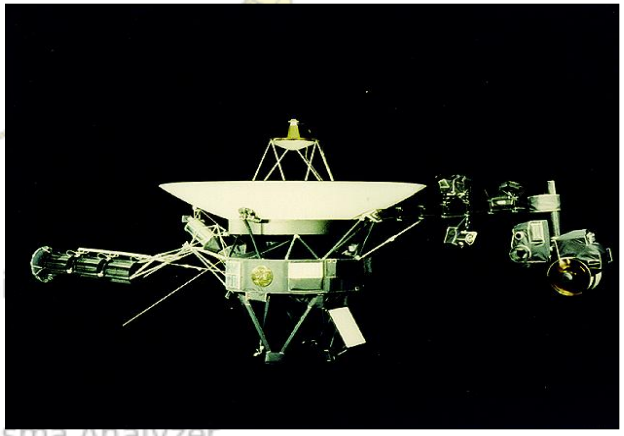
Successful Missions



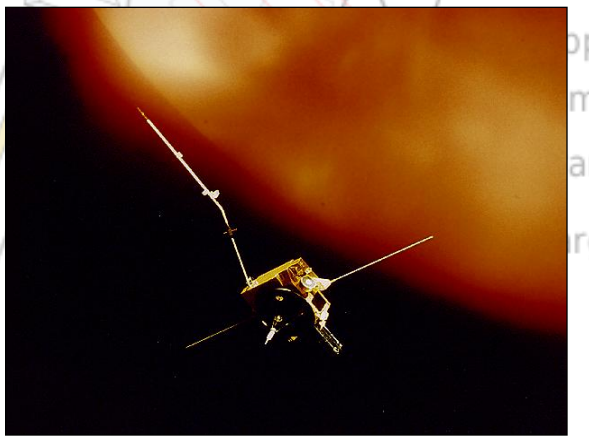
Apollo (1969 - 1972)

Pioneer 10 (1972)

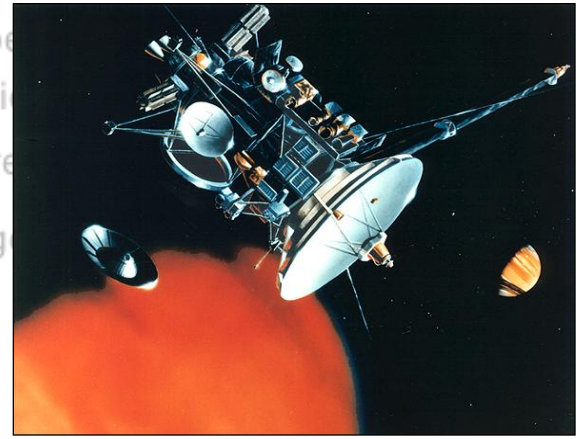


Voyager (1977)

Galileo (1989)



Ulysses (1990)



Cassini (1997)

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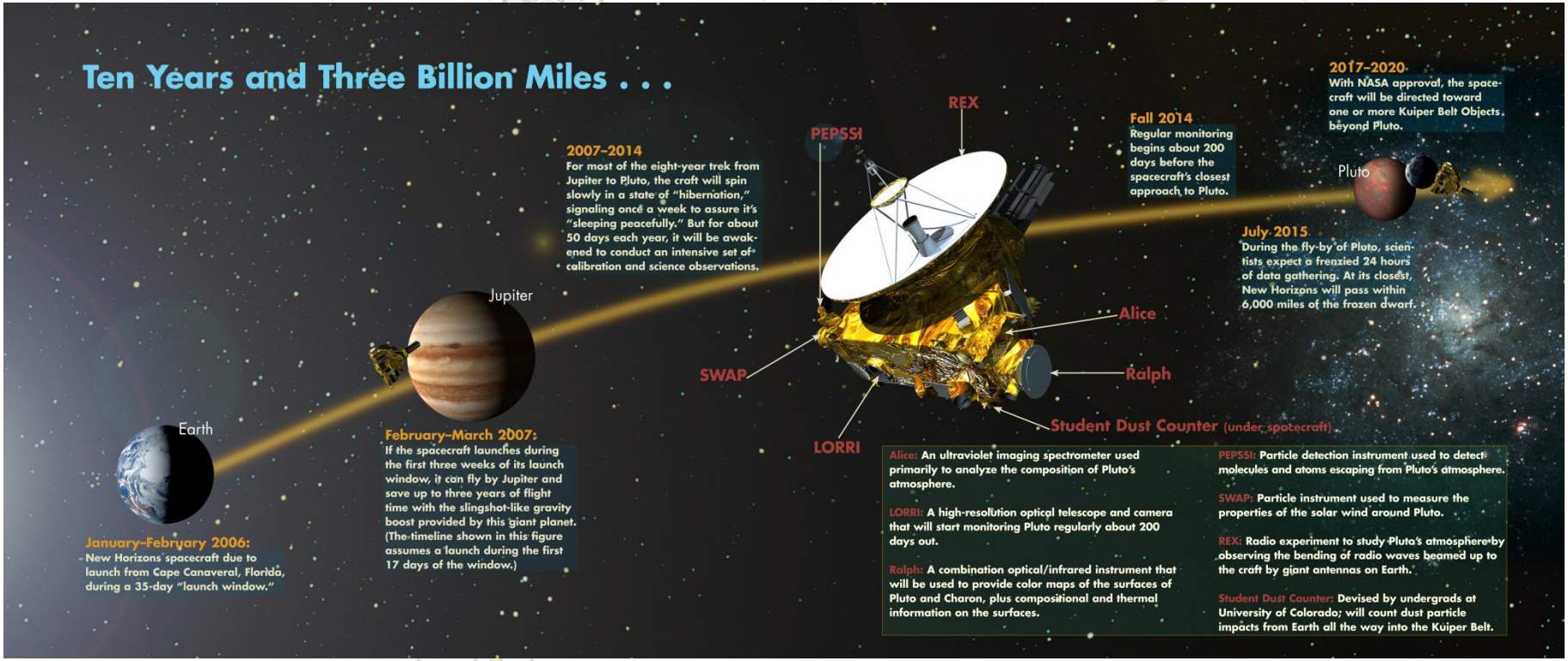
New Horizons-Pluto



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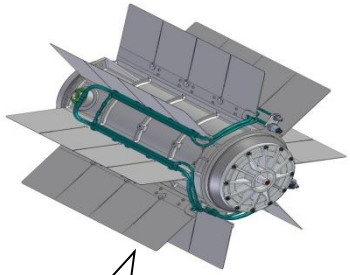
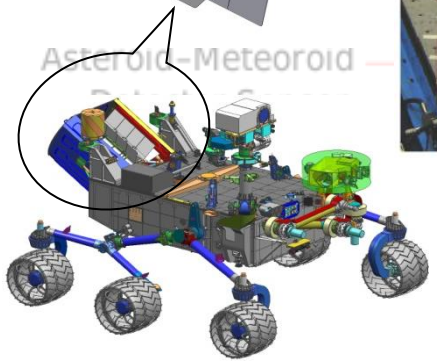
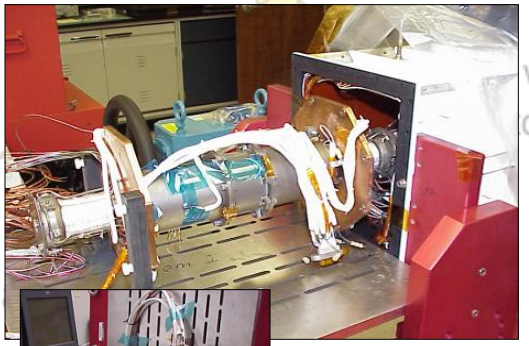
Ongoing RPS Projects Managed by DOE

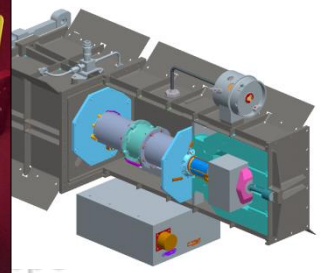




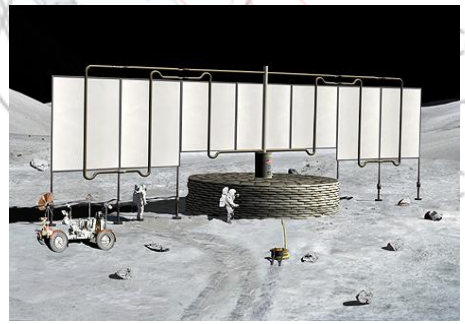
Mars Science Laboratory

Multi-Mission Radioisotope Thermoelectric Generator (MMRTG)





Advanced Stirling Radioisotope Generator (ASRG)



Fission (Reactor) Surface Power System

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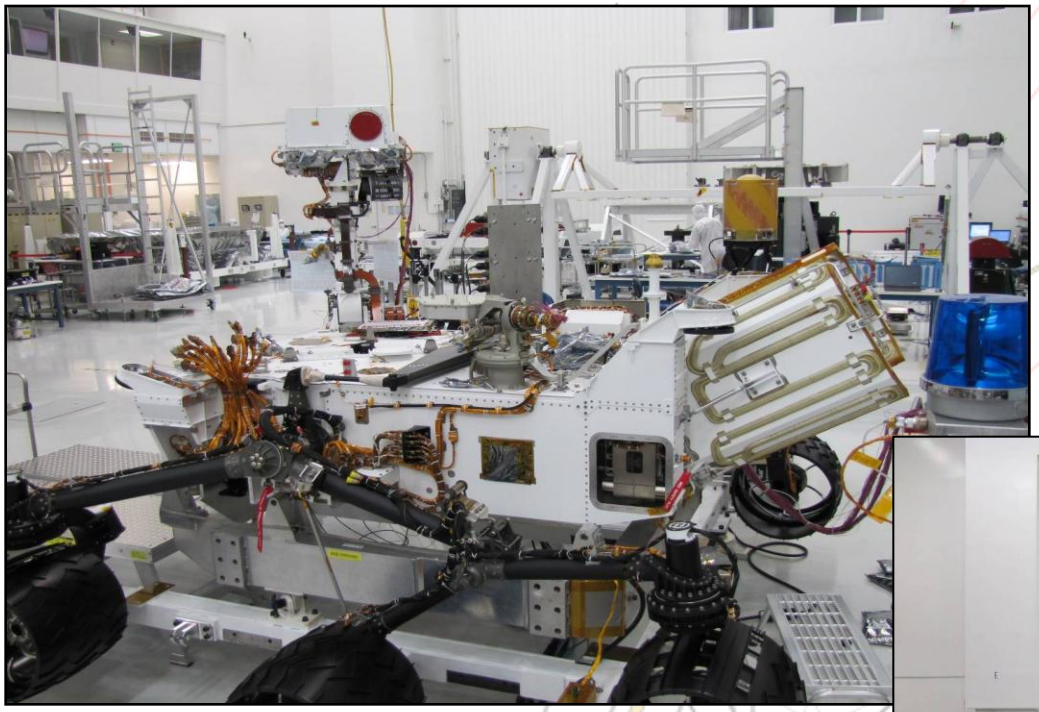
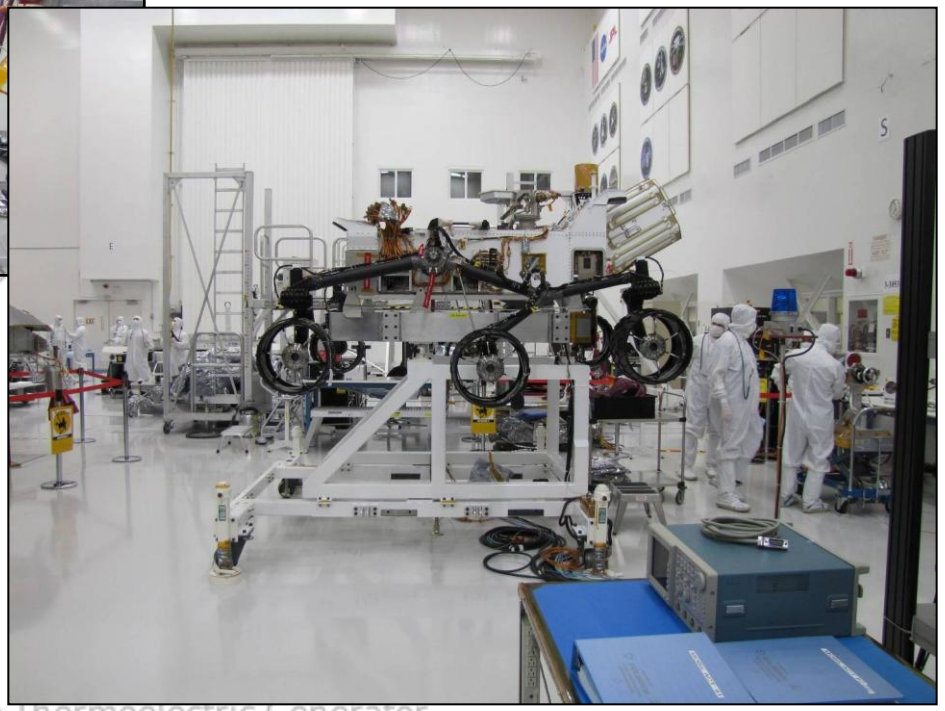
Mars Science Laboratory-Rover





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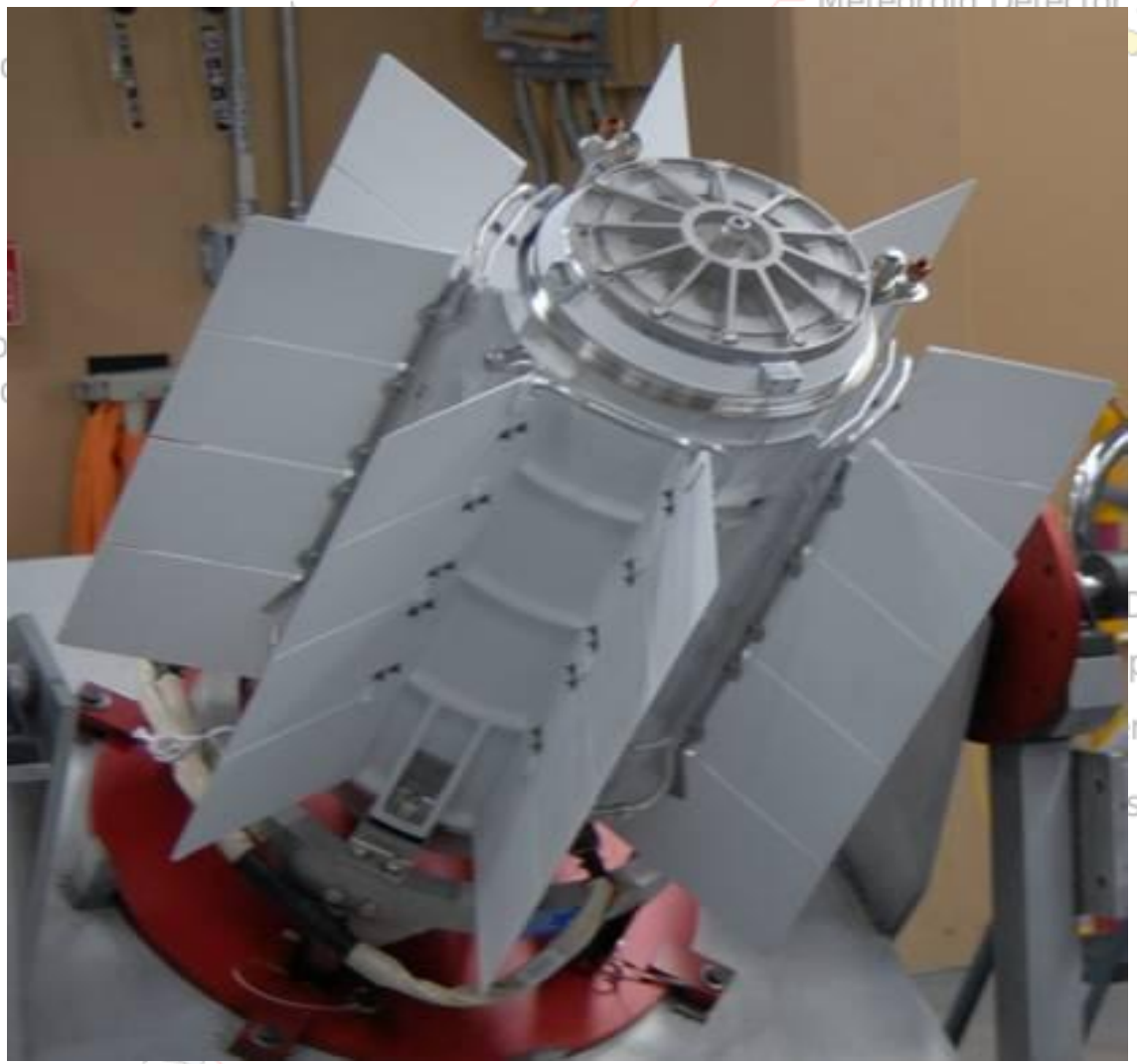
MMRTG



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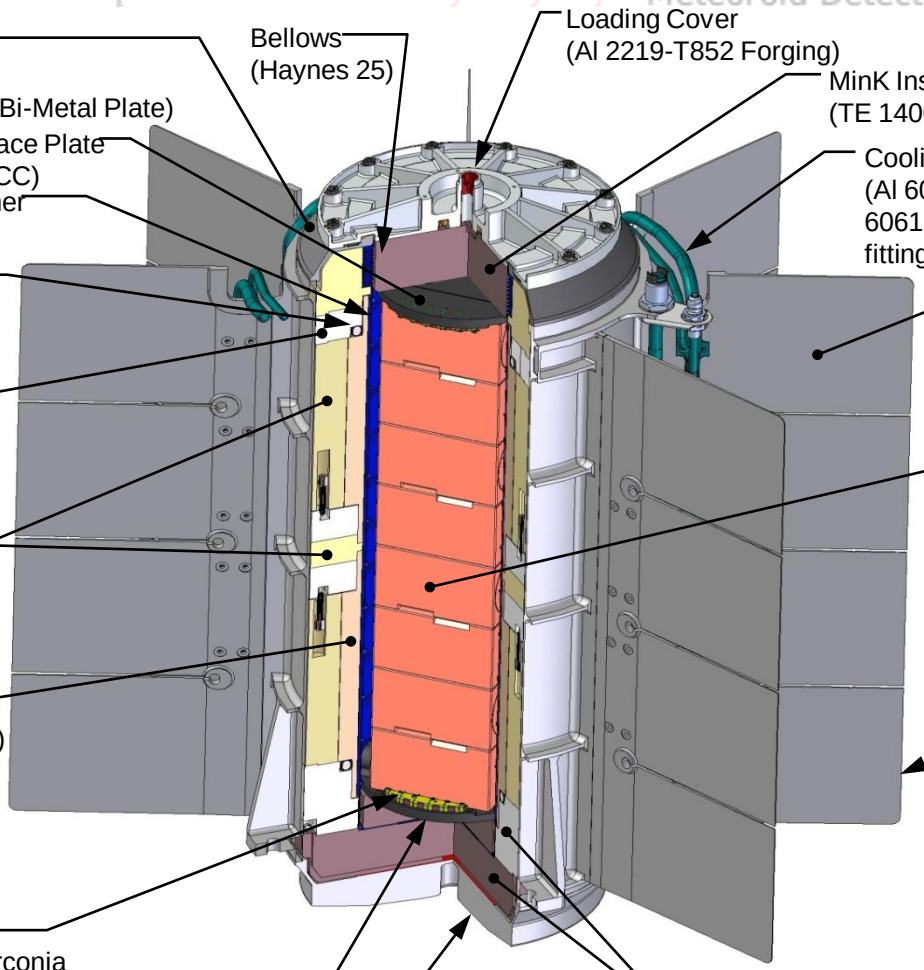
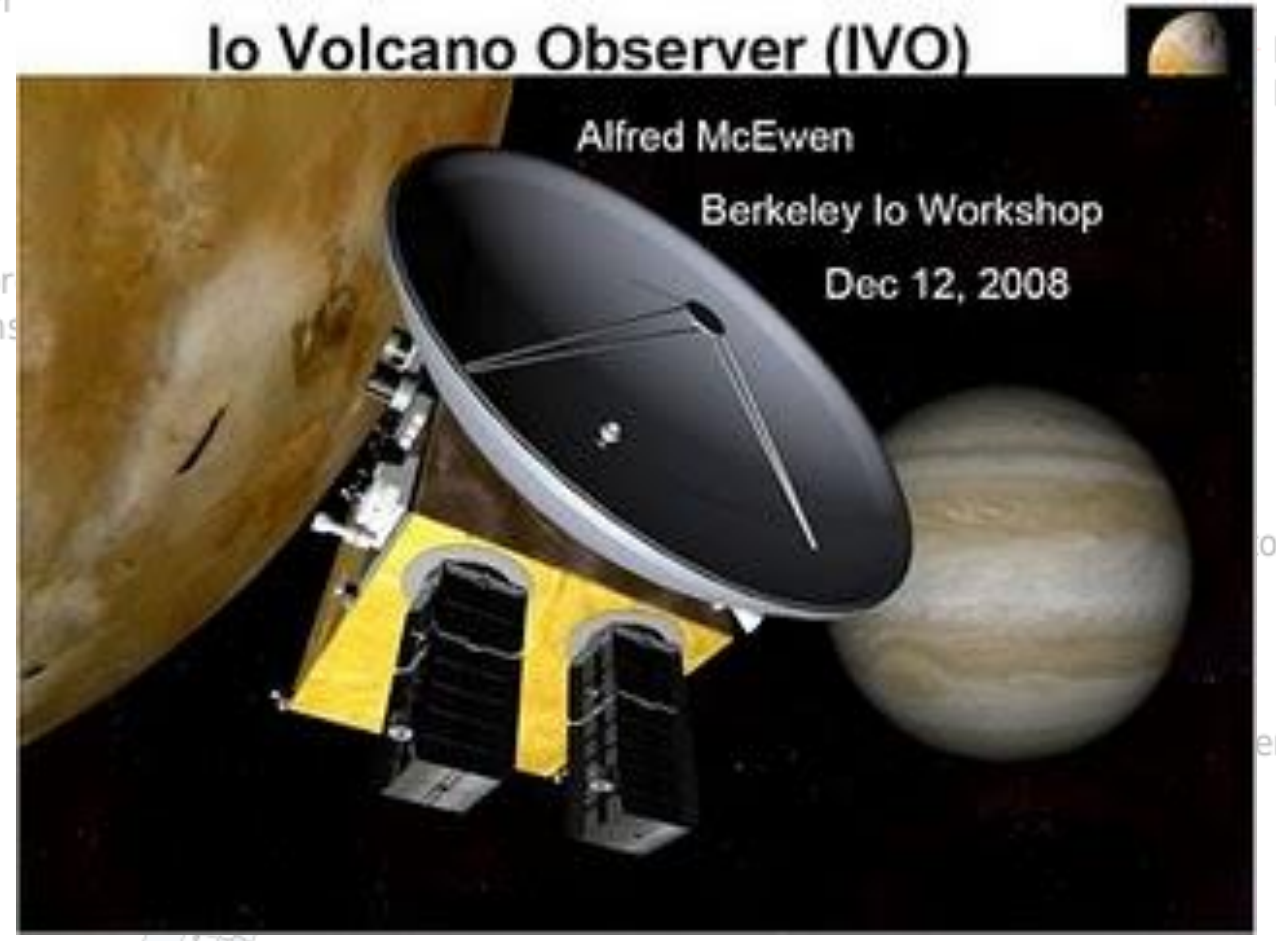
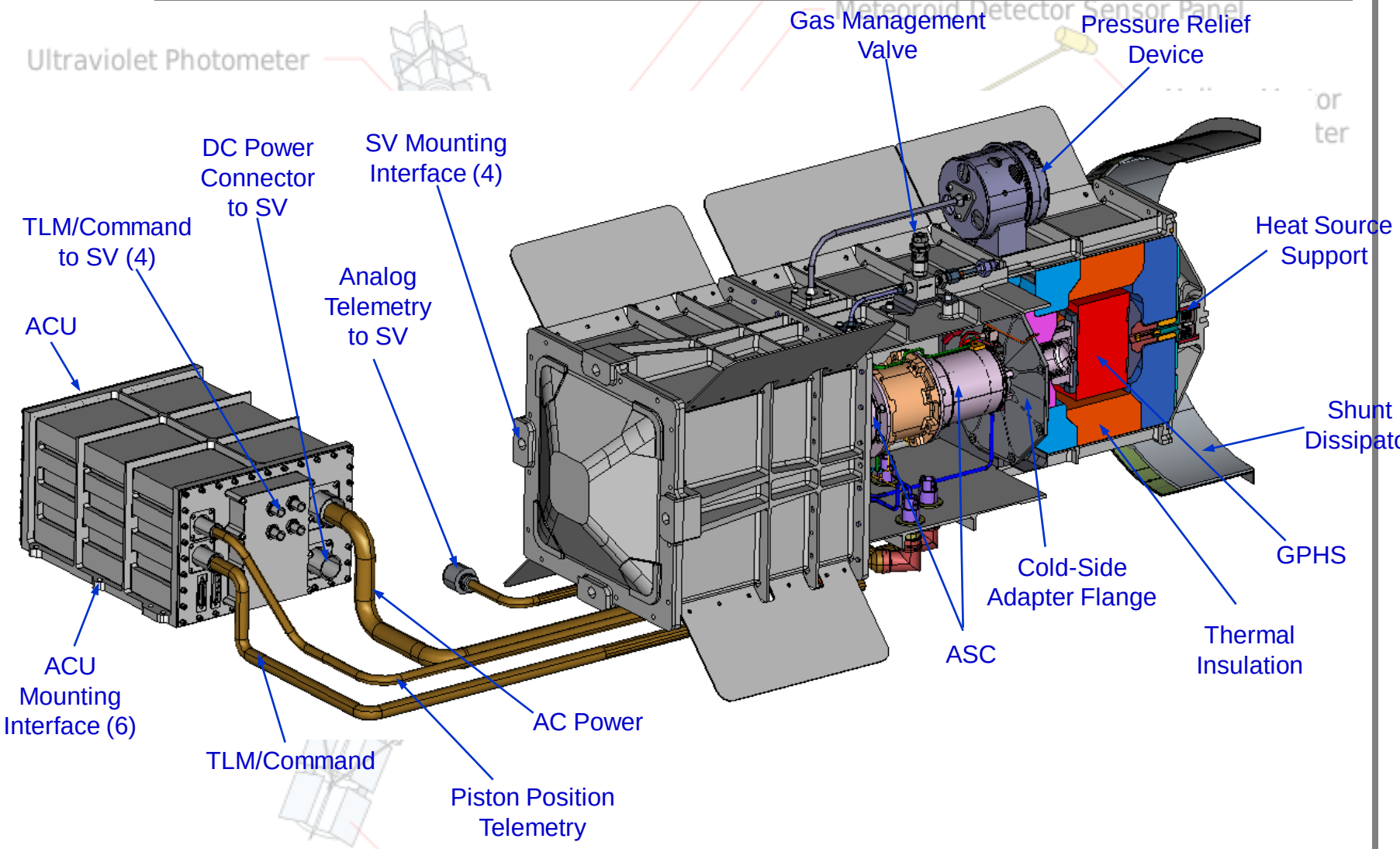
MMRTG



Discovery Mission-ASRG



ASRG


Gas Management Valve
Pressure Relief Device
DC Power Connector to SV
SV Mounting Interface (4)
TLM/Command to SV (4)
Analog Telemetry to SV
Heat Source Support
ACU
Shunt Dissipato
GPHS
Cold-Side Adapter Flange
ASC
Thermal Insulation
ACU Mounting Interface (6)
AC Power
TLM/Command
Piston Position Telemetry

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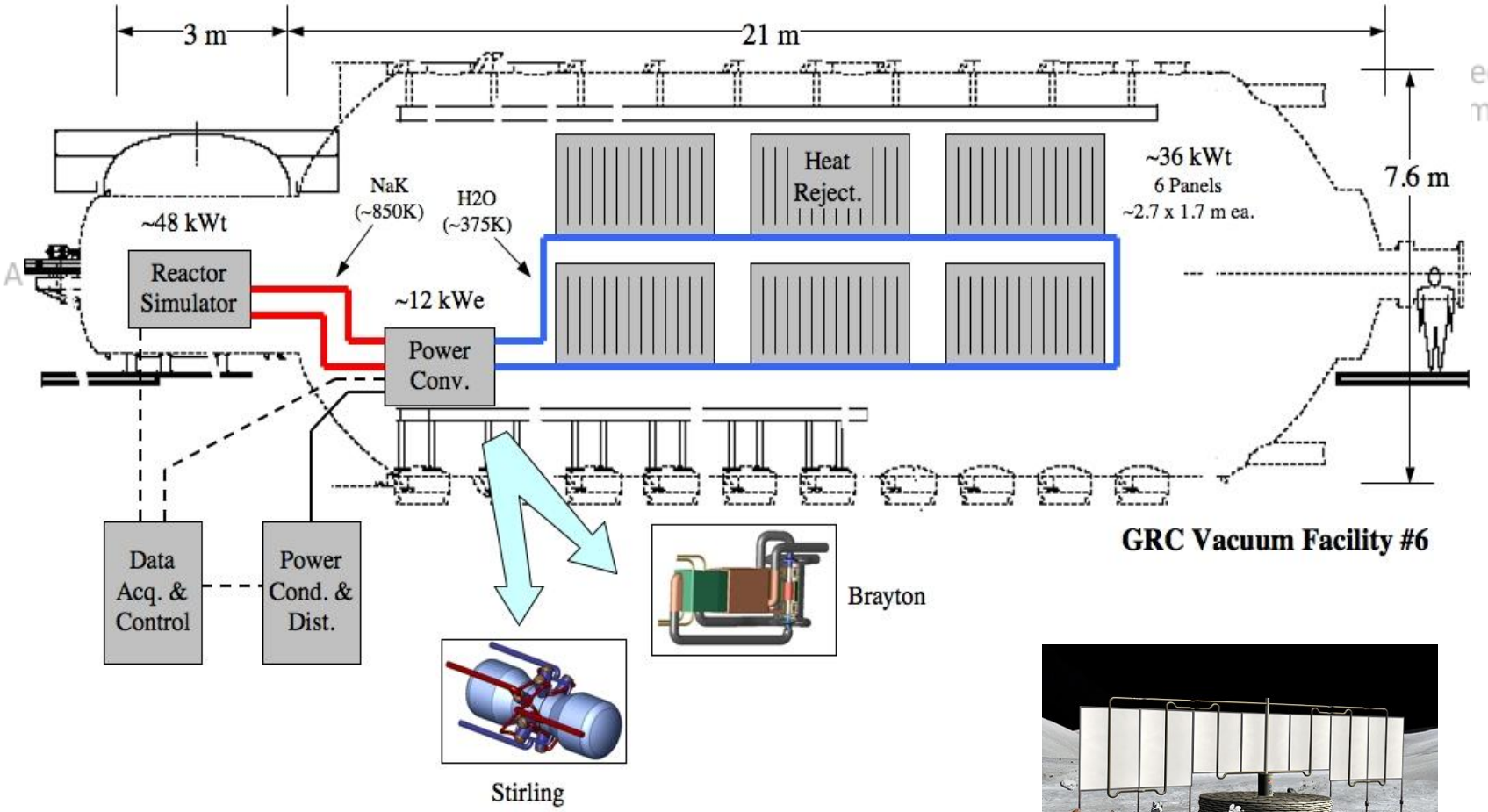
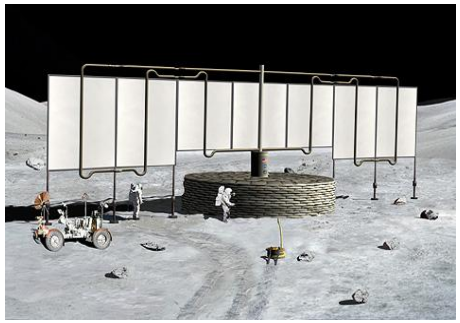
Fission Surface Power System

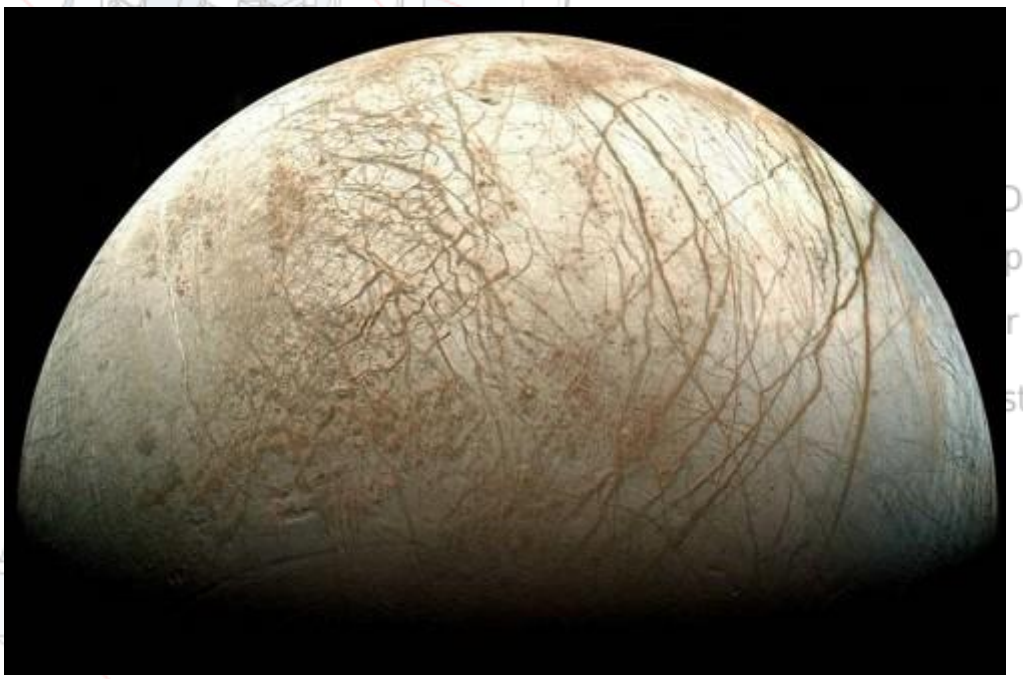
for potential missions in 2030s





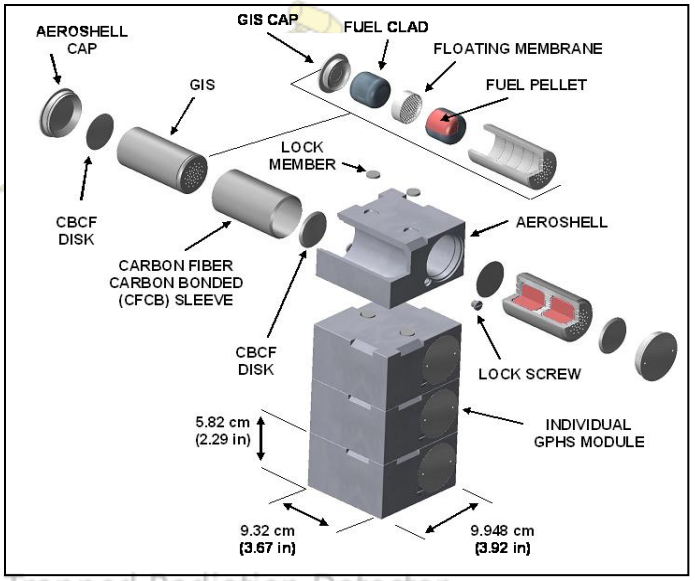
Future Missions & Applications

- NASA letter to Dr. Chu dated March 25, 2010 identifies 9 future missions
  - Chief among them is a major mission to Europa in the Jupiter system. Likely to be powered by an RPS system.
  - The goal of this major mission is to determine whether the Jupiter system harbors habitable worlds.

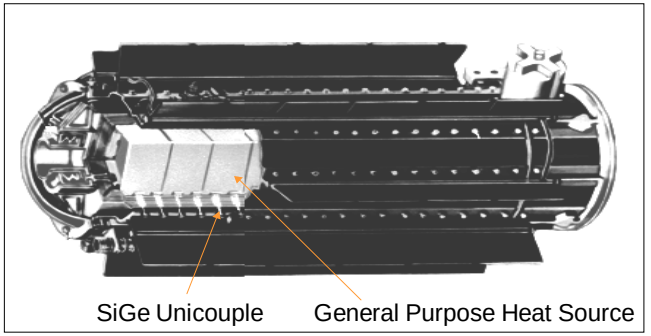


Radioisotope Power Systems *Key Components*

- Pu-238 fuel (generates heat)
- Cladding (encases the fuel)
- Graphite heat source (protects fuel & cladding)
- Converter (converts heat to electricity)
  - Thermoelectrics
  - Stirling
- Radiator (rejects excess heat)



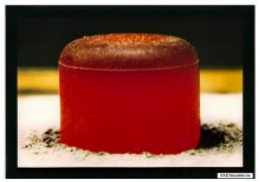
General Purpose Heat Source Module



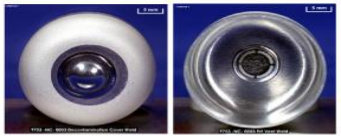
Radioisotope Thermoelectric Generator

RPS Process Flow and Responsibilities

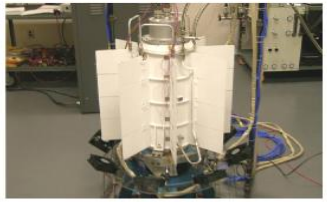
Plutonium Oxide (PuO_2) Fuel Pellet Production
LANL



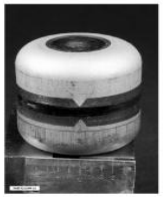
Iridium Component Fabrication
ORNL



Generator
Design Architect/System Integration Contractor (DA/SIC)



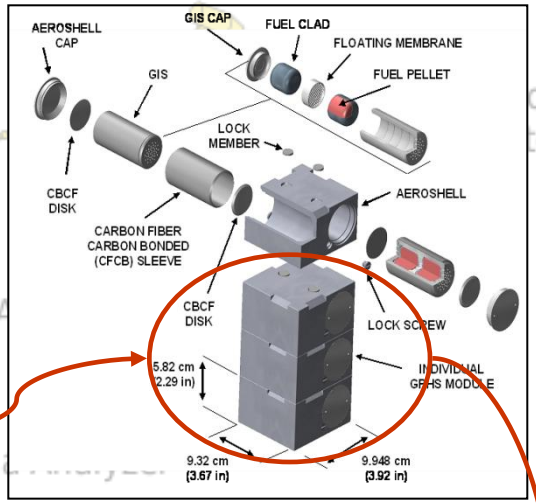
Fuel Pellet Encapsulation
LANL



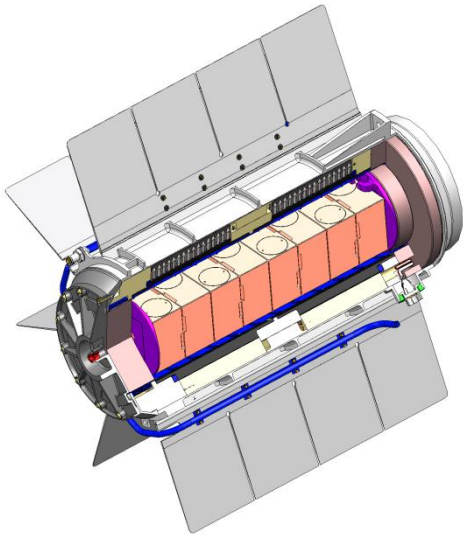
General Purpose Heat Source Module Assembly
INL

RPS Assembly and Testing
INL

RPS Shipment to KSC
INL

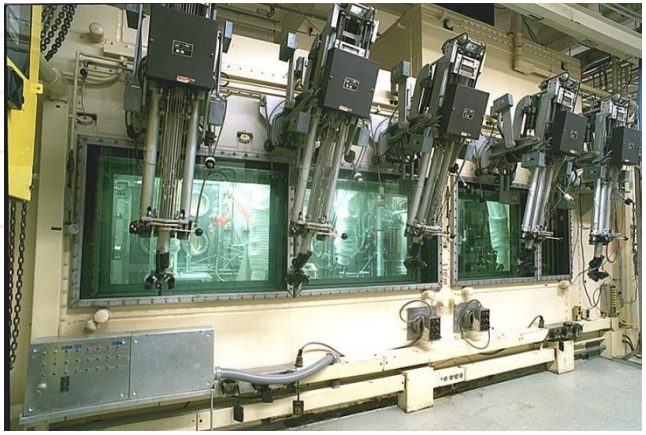


General Purpose Heat Source Module



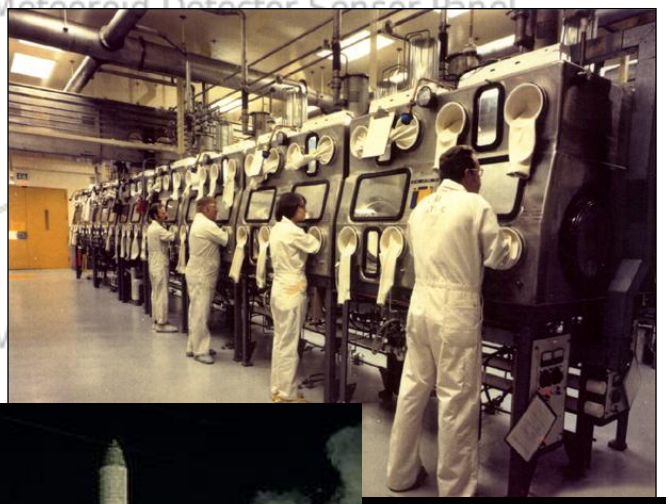
Delivering Nuclear Solutions for America's Energy Challenges

Facilities



Success Factors

- Unique facilities
- Isotope supply
  - Pu-238 is the isotope of choice
- Systems integration contractor
- Exotic materials supply, e.g.
  - iridium clads,
  - fine weave pierced fabric,
  - carbon bonded carbon fiber.
- Skilled people
- Safety of each launch



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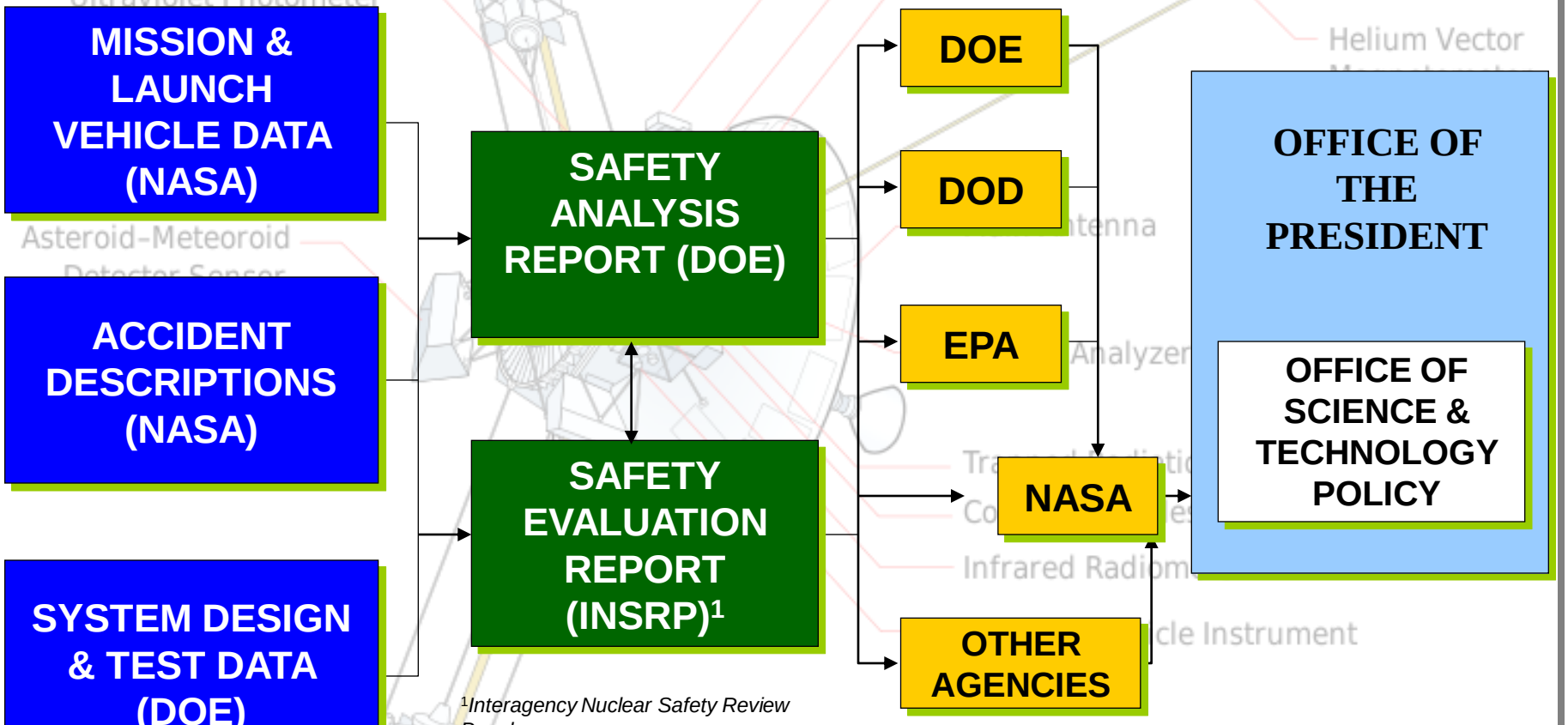
Nuclear Safety Review and Launch Approval Process



[1] *Interagency Nuclear Safety Review Panel*

DOE prepares a nuclear risk assessment which will be used by the Office of President to make a decision to authorize a launch using nuclear materials.